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ABSTRACT

This study assesses the utility of the Armed Services Vocational Aptitude Battery (A.S.V.A.B.) in predicting the academic success of students enrolled in the Automotive Service Specialist curriculum at the State University of New York Agricultural and Technical College (Alfred, New York). This document, part I of a two-part study, describes the relative performances of selected subgroups of the Automotive Service Specialist students on the A.S.V.A.B. A total of 211 of the 217 students in the program took part in this study. Of those participating, 116 were entering freshmen, 78 were continuing seniors, and the remainder were students enrolled in a novel time-shorted degree program involving the New York State Board of Cooperative Education Services (B.O.C.E.S.). Compared with both regional and national normative groups, the population being tested showed average scores which were: somewhat lower on the coding speed test; approximately equal on arithmetic reasoning; somewhat higher on word knowledge and space perception; and notably higher on tool knowledge, mechanical comprehension, shop information, automotive information, and electronics information. Substantial similarity in Test and Aptitude Area composite scores was found for the continuing seniors and B.O.C.E.S. graduates. Entering freshmen scored lower in both areas. Tables of data are appended. (Author/NHM)

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PREDICTING ACADEMIC SUCCESS IN A POST-SECONDARY VOCATIONAL STUDIES PROGRAM UTILIZING THE A.S.V.A.B.

PART ONE

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INTRODUCTION

This is a report on the preliminary findings of a study designed to assess the validity and utility of the Armed Services Vocational Aptitude Battery (A.S.V.A.B.) in predicting the academic success of students enrolled in the Automotive Service Specialist curriculum, a two-year A.O.S. degree program offered at the School of Vocational Studies of the State University of New York Agricultural and Technical College at Alfred, New York. The primary objective of this two-part study is to investigate systematically and statistically the relationships between student performance on the A.S.V.A.B. and their performance within the automotive curriculum, with a view toward assessing the potential of the A.S.V.A.B. for predicting the probability of student attrition as well as the degree of academic achievement.

While Part Two of this report will address itself to the exploration of the nature and magnitude of the variety of relationships suggested above, the concern here is simply with a description of the relative performance of selected subgroups of Automotive Service Specialist students on the A.S.V.A.B. Specifically, we are interested in comparing the performance of Entering Freshmen, Continuing Seniors, and B.O.C.E.S. Graduates (those students who participated in the Summer, 1975 "B.O.C.E.S. Advanced Standing Program") with one another and with Regional and National Norms.

Presentation and discussion of the findings is preceded by brief descriptions of the test instrument, the student sub-groups, and the test-administration and data analysis processes.

THE A.S.V.A.B.

Available through the United States Department of Defense, the Armed Services Vocational Aptitude Battery is a battery of nine standardized, group-administered, and timed tests, which is designed to measure certain vocational skills and knowledge, and which appears to exhibit acceptable levels of reliability and validity.[1] The nine tests are identified and described briefly as follows:[2]

1. Coding Speed Test (CS). This is a test of clerical speed and accuracy. At the top of each test page is a group of words with a code number beside each word. Each test item consists of one of the key words from the top of the page, followed by five code numbers. The examinee's task is to identify the correct code number for that word in accordance with the code at the top of the page. The test emphasizes speed; the examinee is given 100 such items and is required to accurately complete as many as possible in seven minutes.

2. Word Knowledge Test (WK). This test presents 25 vocabulary words. Each of the vocabulary words is contained in a sentence and is followed by four alternative answers. From among the four alternatives, the examinee must select the word which means most nearly the same thing as the underlined word in the item stem. In this and all subsequent tests in the battery, speed is not emphasized; while there is a time limit on the tests, it is ample for most examinees.

3. Arithmetic Reasoning Test (AR). This test presents 25 reasoning problems involving arithmetic processes. For each problem, the examinee must solve the problem and select the correct answer from among four alternatives.

[1]See, for example, Harry D. Wilfong, R. J. Armstrong, and R. K. Huckell, Jr. Percentile Normative Tables for the Armed Services Vocational Aptitude Battery (1973-74 School Year Base), Randolph Air Force Base, Texas: Research Division Armed Forces Vocational Testing Group, December, 1974; and Randolph K. Harris and R. K. Huckell, Jr., Predicting Academic Success in Secondary Schools from the General Technical Composite on the Armed Services Vocational Aptitude Battery, Randolph Air Force Base, Texas: Research Division Armed Forces Vocational Testing Group, December, 1974.

[2]The Test and Aptitude Area descriptions which follow are taken from, Armed Forces Vocational Testing Group, Counselor's Manual Volume I ASVAB, Universal City, Texas: Armed Forces Vocational Testing Group, 1974. This manual also contains data on reliability and validity of the A.S.V.A.B.

4. Tool Knowledge Test (TK). This test has 25 pictorial questions about tools and equipment. Each item presents a picture of a tool or piece of equipment, followed by four more drawings of various tools or pieces of equipment. The examinee must select the one of the four alternatives that "goes best" with the stem.

5. Space Perception Test (SP). This is also a pictorial test. It consists of 25 items, each of which shows a flat pattern followed by four drawings of three-dimensional figures. Broken lines on the pattern show where it is to be folded. The subject's task is to select the one of the three-dimensional figures which could be made from the pattern by folding it on the dotted lines.

6. Mechanical Comprehension (MC). This is a 25 item test in which a drawing illustrates a mechanical principle and a question is asked about it. The correct answer must be selected from four alternatives.

7. Shop Information Test (SI). In this test, about half the items contain drawings. The test consists of 25 questions about shop practices and the use of tools. The examinee is to select the correct answer from among four alternatives.

8. Automotive Information Test. (AI). This test has 25 questions about automobile parts or their operation. The correct answer must be selected from four alternatives.

9. Electronics Information Test (EI). This test consists of 25 questions involving elementary principles of electricity and electronics. The examinee must select the correct answer to each question from among four alternatives.

Selected combinations of scores on eight of the tests are used to define and measure five "composite" scores relating to the following Aptitude Areas:

GENERAL/TECHNICAL--describes the student's ability for occupations requiring academic ability. The composite is composed of verbal and mathematical components of the battery.

CLERICAL/ADMINISTRATIVE--describes the student's ability relevant to clerical and administrative occupations. The composite is composed of the battery components concerned with verbal ability and clerical speed and accuracy.

ELECTRONICS--describes student's ability relevant to electrical and electronic occupations. The composite consists of tests dealing with electrical information and with understanding of mechanical principles.

GENERAL MECHANICS--describes student's ability in terms of those capabilities relevant to a variety of mechanical and trade jobs. The composite consists of tests assessing shop information and spatial ability.

MOTOR MECHANICS--describes the student's ability relevant to engine repair and other related jobs. It is composed of measures of automotive information and understanding of mechanical principles.

Administration and scoring of the A.S.V.A.B. are services provided by the Department of Defense at no cost to participating institutions, and a normative base has been developed which allows an institution to compare its students' scores with Regional and National Norms. Norms by sex are available for grades 10, 11, and 12, and, while post-secondary norms are being developed, the size of the available post-secondary normative base is too small currently to allow meaningful comparisons.

THE STUDENT SUBGROUPS

A total of 211 of 217 Automotive Service Specialist students took part in this study. Of those participating, 116 were Entering Freshmen, 78 were Continuing Seniors, and the remainder were students enrolled in a novel time shortened degree program involving the New York State Board of Cooperative Education Services (B.O.C.E.S.). This latter sub-group consisted of 17 of the 22 students who participated in the Summer, 1975 "B.O.C.E.S. Advanced Standing Program." The program, which is currently in the pilot stage, is designed specifically for the two-year B.O.C.E.S.

graduate. It involves an eight-week summer school at the College, which, together with the prior B.O.C.E.S. training, is intended to substitute for the freshman year of the Automotive Service Specialist A.O.S. program. Of the 17 B.O.C.E.S. students taking part in this study, 15 had been successful in completing the summer school and held senior status, while 2 had been unsuccessful and were registered as freshmen.

THE TEST ADMINISTRATION AND DATA ANALYSIS

On September 4, 1975, the A.S.V.A.B. was administered to the 211 Automotive Service Specialist students in a group and timed situation at the College's School of Vocational Studies' Campus in Wellsville, New York. The administration, lasting approximately two and one-half hours, was overseen by a United States Army Sergeant, who had had expert knowledge of and extensive previous experience in administering the A.S.V.A.B.

The Test and Aptitude Area scores of the 211 students were received in the College's Office of Institutional Research by September 30, 1975. The analysis of these data was facilitated by the assistance of the Director of the Computer Center, who wrote and ran the program for the calculation of the means and standard deviations.

FINDINGS

Comparison with Normative Groups

Table 1 displays the means and standard deviations for the three student subgroups and for the Regional and National Normative Groups. Since detailed comparisons among the Automotive Service Specialist student subgroups are the subjects of subsequent tables, our observations here are

restricted to comparisons with the Regional and National Norms. In that regard, we note that, compared with both Regional and National Normative Groups, students enrolled in the Automotive Service Specialist curriculum show average scores which are:

1a. Somewhat lower on the Coding Speed Test;

2a. Approximately equal on the Arithmetic Reasoning Test;

3a. Somewhat higher on the Word Knowledge and Space Perception Tests;

4a. Notably higher on the Tool Knowledge, Mechanical Comprehension, Shop Information, Automotive Information, and Electronics Information Tests;

and

1b. Notably higher on the Aptitude Areas of CLERICAL/ADMINISTRATIVE and GENERAL TECHNICAL;

2b. Dramatically higher on the Aptitude Areas of ELECTRONICS, MOTOR MECHANICS, and GENERAL MECHANICS.

Comparison of B.O.C.E.S. Graduates with Continuing Seniors

Substantial similarity in Test and Aptitude Area scores between B.O.C.E.S. Graduates and Continuing Seniors is suggested by the data of Table 2. Interestingly, in three of the Tests and in Two of the Aptitude Areas B.O.C.E.S. Graduates show average scores which are somewhat higher than those for the Continuing Seniors. Only two of the mean differences are statistically significant, however, those for the Tool Knowledge and Shop Information Tests.

Comparison of B.O.C.E.S. Graduates with Entering Freshmen

The statistics of Table 3 reveal that the B.O.C.E.S. Graduates score significantly higher than the Entering Freshmen on 5 out of 9 Tests and 3 out of 5 Aptitude Areas. The evidence strongly suggests

the superiority of B.O.C.E.S. Graduates participating in the time-shortened degree program with respect to Tool Knowledge, Mechanical Comprehension, Shop Information, Automotive Information, and Electronics Information. Similarly, they show significantly higher than average scores in the ELECTRONICS, MOTOR MECHANICS, and GENERAL MECHANICS Aptitude Areas.

Comparison of Continuing Seniors with Entering Freshmen

The data of Table 4 reveal that the Continuing Seniors score significantly higher than the Entering Freshmen on the Mechanical Comprehension, Automotive Information, and Electronics Information Tests, and in the ELECTRONICS and MOTOR MECHANICS Aptitude Areas.

Table 1: Performance of Entering Freshmen, Continuing Seniors, and B.O.C.E.S. Graduates Enrolled in the Automotive Service Specialist Program on the Armed Services Vocational Aptitude Battery (A.S.V.A.B.), with Normative Data for the New York, Pennsylvania and Delaware Region and for the total United States, Expressed in Terms of Means ($\bar{X}$'s) and Standard Deviations (S's).

A.S.V.A.B. Tests and Aptitude Areas	B.O.C.E.S. Graduates $N_1=17$		Continuing Seniors $N_2=78$		Entering Freshman $N_3=116$		Regional Norms (12th Grade Males) $N_r=25,273$		National Norms (12th Grade Males) $N_n=216,238$	
	$\bar{X}_1$	S_1	$\bar{X}_2$	S_2	$\bar{X}_3$	S_3	$\bar{X}_r$	S_r	$\bar{X}_n$	S_n
Tests										
Coding Speed	46.9	9.9	45.4	10.7	44.3	8.5	48.5	13.2	47.3	13.2
Word Knowledge	16.2	3.3	16.1	3.3	15.8	3.8	15.3	4.3	14.3	4.9
Arithmetic Reasoning	14.4	3.8	15.9	4.4	15.3	4.7	15.7	5.5	14.8	5.8
Tool Knowledge	21.5	2.7	19.6	3.5	19.3	3.7	15.2	5.2	15.2	5.2
Space Perception	16.6	5.5	16.4	4.8	16.4	4.6	15.2	5.6	14.6	5.7
Mech. Comprehension	19.6	2.7	19.2	3.2	17.9	3.7	15.2	4.6	14.7	4.8
Shop Information	21.9	2.1	20.1	2.6	19.6	3.4	15.3	4.7	15.2	4.6
Automotive Infor.	23.6	1.3	23.5	1.5	20.7	3.4	14.3	4.7	15.0	4.8
Electronics Infor.	19.8	3.1	20.4	2.6	18.1	4.2	14.9	5.0	14.5	5.0
APTITUDE AREAS										
ELECTRONICS	91.5	9.0	92.8	7.8	84.7	17.7	44.9	13.2	43.8	13.6
MOTOR MECHANICS	98.3	1.1	97.8	2.5	91.6	11.5	43.8	12.2	44.6	12.5
GENERAL MECHANICS	92.1	8.1	87.6	13.0	85.8	13.8	45.8	12.7	44.9	12.8
CLERICAL/ADMIN.	54.6	22.7	52.0	22.6	48.3	22.2	31.2	7.0	29.8	7.6
GENERAL TECHNICAL	58.6	21.9	63.1	22.0	60.1	24.3	31.1	8.6	29.1	9.5

Table 2: Comparison of the Performance of B.O.C.E.S. Graduates with that of Continuing Seniors on the Armed Services Vocational Aptitude Battery (A.S.V.A.B.), Expressed in Terms of Mean Differences ($\bar{X}_1 - \bar{X}_2$) and Results of Appropriate Two-Sample t-tests.*

A.S.V.A.B. Tests And Aptitude Areas	Average Scores of B.O.C.E.S. Graduates Minus Average Scores of Continuing Seniors $\bar{X}_1 - \bar{X}_2$	Significance Levels and	Degrees of Freedom
Tests			
Coding Speed	1.5	Not Significant	
Word Knowledge	.1	Not Significant	
Arithmetic Reasoning	-1.5	Not Significant	
Tool Knowledge	1.9	.05	27
Space Perception	.2	Not Significant	
Mech. Comprehension	.4	Not Significant	
Shop Information	1.8	.01	26
Automotive Infor.	.1	Not Significant	
Electronics Infor.	- .6	Not Significant	
APTITUDE AREAS			
ELECTRONICS	-1.3	Not Significant	
MOTOR MECHANICS	.5	Not Significant	
GENERAL MECHANICS	4.5	Not Significant	
CLERICAL/ADMIN.	2.6	Not Significant	
GENERAL TECHNICAL	-4.5	Not Significant	

*All are two-tailed tests ($H_1: \mu_1 \neq \mu_2$)

Table 3: Comparison of the Performance of B.O.C.E.S. Graduates with that of Entering Freshmen on the Armed Services Vocational Aptitude Battery (A.S.V.A.B.), Expressed in Terms of Mean Differences ($\bar{X}_1 - \bar{X}_3$) and Results of Appropriate Two-Sample t-tests.*

A.S.V.A.B. Tests And Aptitude Areas	Average Scores of B.O.C.E.S. Graduates Minus Average Scores of Entering Freshmen $\bar{X}_1 - \bar{X}_3$	Significance Levels	and Degrees of Freedom
Tests			
Coding Speed	2.6	Not Significant	
Word Knowledge	.4	Not Significant	
Arithmetic Reasoning	- .9	Not Significant	
Tool Knowledge	2.2	.005	32
Space Perception	.2	Not Significant	
Mech. Comprehension	1.7	.025	32
Shop Information	2.3	.0005	26
Automotive Infor.	2.9	.0005	38
Electronics Infor.	1.7	.05	26
APTITUDE AREAS			
ELECTRONICS	6.8	.01	36
MOTOR MECHANICS	6.7	.0005	80
GENERAL MECHANICS	6.3	.01	30
CLERICAL/ADMIN.	6.3	Not Significant	
GENERAL TECHNICAL	-1.5	Not Significant	

* All are one-tailed tests ($H_1: \mu_1 > \mu_3$)

Table 4: Comparison of the Performance of Continuing Seniors with that of Entering Freshmen on the Armed Services Vocational Aptitude Battery (A.S.V.A.B.), Expressed in Terms of Mean Differences ($\bar{X}_2 - \bar{X}_3$) and Results of Appropriate Two-Sample t-tests.*

A.S.V.A.B. Tests And Aptitude Areas	Average Scores of Continuing Seniors Minus Average Scores of Entering Freshmen $\bar{X}_2 - \bar{X}_3$	Significance and Levels	Degrees of Freedom
Tests			
Coding Speed	1.1	Not Significant	
Word Knowledge	.3	Not Significant	
Arithmetic Reasoning	.6	Not Significant	
Tool Knowledge	.3	Not Significant	
Space Perception	0	Not Significant	
Mech. Comprehension	1.3	.005	120+
Shop Information	.5	Not Significant	
Automotive Infor.	2.8	.0005	120+
Electronics Infor.	2.3	.0005	120+
APTITUDE AREAS			
ELECTRONICS	8.1	.0005	120+
MOTOR MECHANICS	6.2	.0005	114
GENERAL MECHANICS	1.8	Not Significant	
CLERICAL/ADMIN.	3.7	Not Significant	
GENERAL TECHNICAL	3.0	Not Significant	

*All are one-tailed tests ($H_1: \mu_2 > \mu_3$)

SUMMARY AND CONCLUSIONS

The findings of this study provide encouraging though general and indirect evidence for the utility of the A.S.V.A.B. in predicting the probability of success in automotive service studies. Compared with Regional and National Normative Groups, students enrolled in the Automotive Service Specialist curriculum showed notably and even dramatically higher scores on the "mechanical-automotive-electronics" Tests and Aptitude Areas. Furthermore, on this same "mechanical-automotive-electronics" cluster, the A.S.V.A.B. appears to exhibit an ability to discriminate among categories of students having different levels of academic training in automotive studies. For example, while the B.O.C.E.S. Graduates participating in the time-shortened degree program showed scores which were approximately equal to the Continuing Seniors, both of these subgroups scored significantly higher than the Entering Freshmen on the "mechanical-automotive-electronics" Tests and Aptitude Areas.

In Part Two of this study, the utility of the A.S.V.A.B. in predicting the probability of student attrition and the degree of academic achievement will be assessed more specifically and directly as interrelationships among Test and Aptitude Area scores and student grade averages are examined using regression and correlation techniques.

STATISTICAL NOTE

For all t-tests employed in this study, it was assumed that $\sigma_1 \neq \sigma_2$. Thus, the standard error of the difference between sample means was calculated as follows:

$$\hat{\sigma}_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{S_1^2}{N_1 - 1} + \frac{S_2^2}{N_2 - 1}}$$

Since the sample sizes exhibited substantial variability, the degrees of freedom were calculated according to the following expression:[3]

$$df = \frac{\left(\frac{S_1^2}{N_1 - 1} + \frac{S_2^2}{N_2 - 1}\right)^2}{\left(\frac{S_1^2}{N_1 - 1}\right)^2 \left(\frac{1}{N_1 + 1}\right) + \left(\frac{S_2^2}{N_2 - 1}\right)^2 \left(\frac{1}{N_2 + 1}\right)} - 2$$

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[3]See Hubert M. Blalock, Jr., Social Statistics, (second edition), New York: McGraw-Hill Book Company, 1972, pp. 226-227.